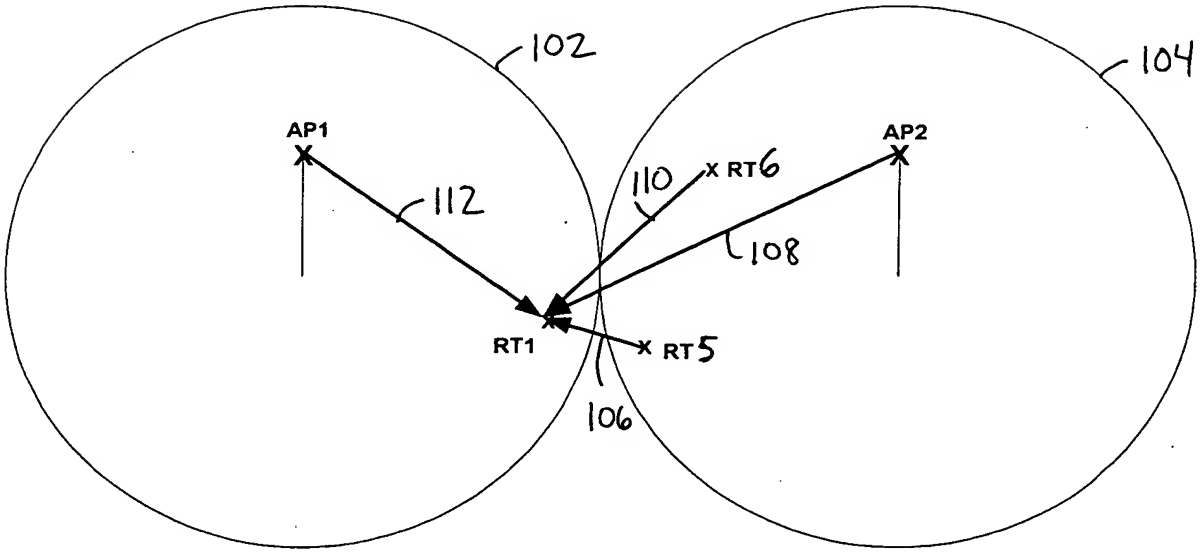
102
104
AP1
AP2
112
110
RT6
108
RT1
RT5
106

FIG. 1

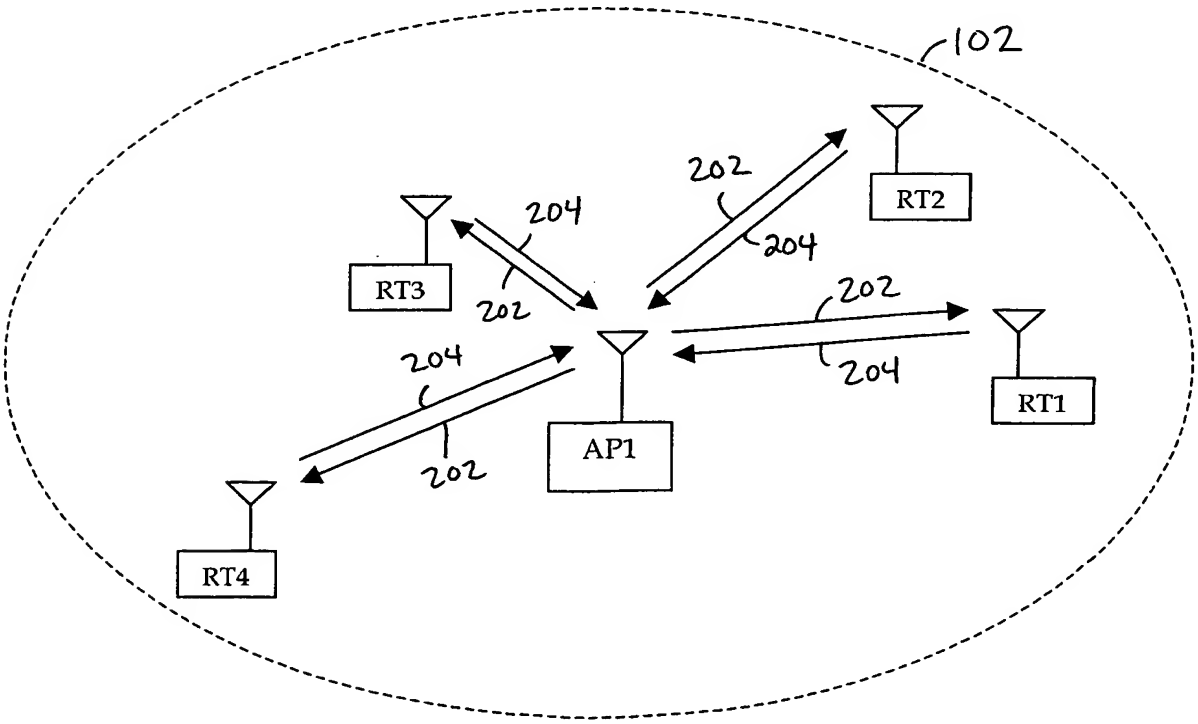
102
RT2
202
204
204
RT3
204
202
202
204
RT1
AP1
204
202
RT4

FIG. 2

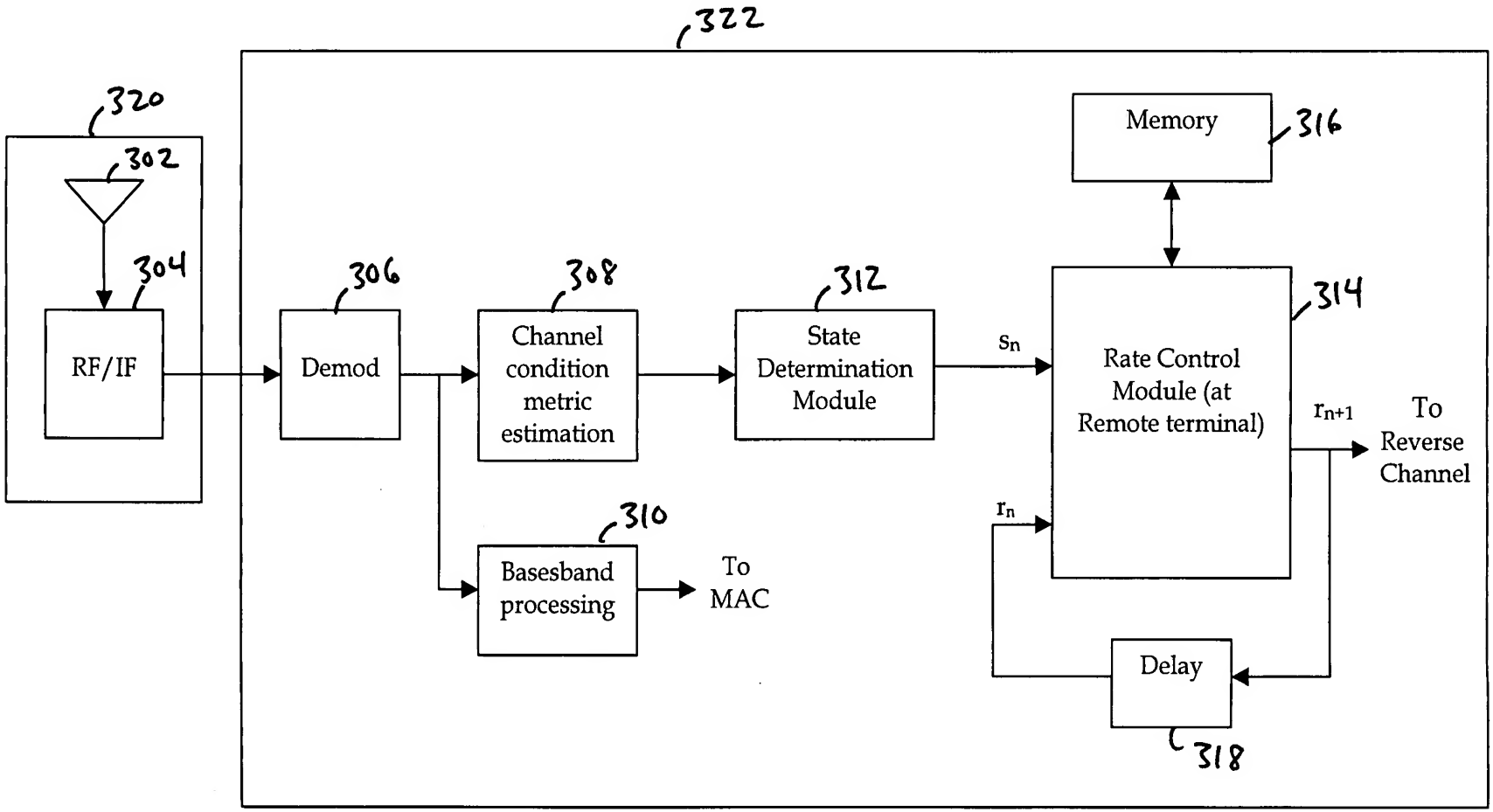
322
320
302
304
RF/IF
306
Demod
308
Channel condition metric estimation
312
State Determination Module
Memory
316
314
Rate Control Module (at Remote terminal)
s_n
r_{n+1}
To Reverse Channel
r_n
310
Basesband processing
To MAC
Delay
318

FIG. 3

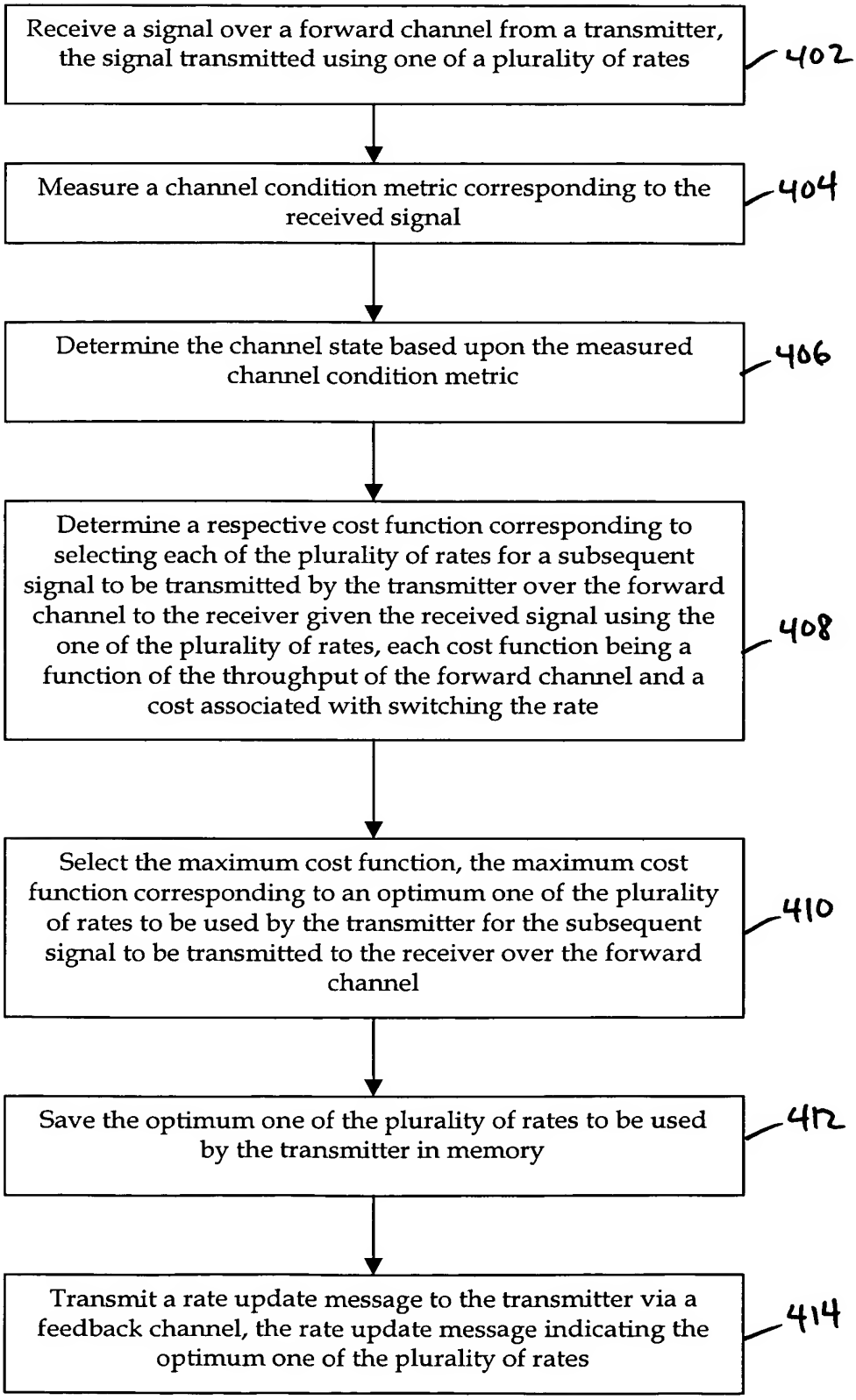
Receive a signal over a forward channel from a transmitter, the signal transmitted using one of a plurality of rates
402
Measure a channel condition metric corresponding to the received signal
404
Determine the channel state based upon the measured channel condition metric
406
Determine a respective cost function corresponding to selecting each of the plurality of rates for a subsequent signal to be transmitted by the transmitter over the forward channel to the receiver given the received signal using the one of the plurality of rates, each cost function being a function of the throughput of the forward channel and a cost associated with switching the rate
408
Select the maximum cost function, the maximum cost function corresponding to an optimum one of the plurality of rates to be used by the transmitter for the subsequent signal to be transmitted to the receiver over the forward channel
410
Save the optimum one of the plurality of rates to be used by the transmitter in memory
412
Transmit a rate update message to the transmitter via a feedback channel, the rate update message indicating the optimum one of the plurality of rates
414

FIG. 4

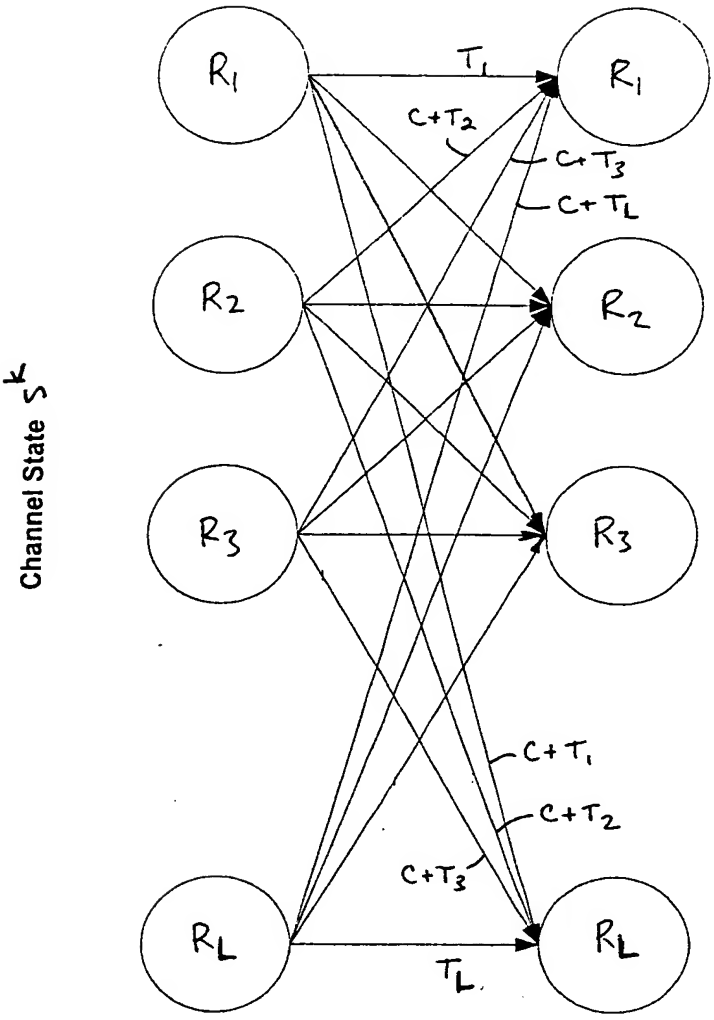
Channel State S^k
R_1
R_2
R_3
R_L
T_1
$C+T_2$
$C+T_3$
$C+T_L$
R_1
R_2
R_3
$C+T_1$
$C+T_2$
$C+T_3$
R_L
T_L

FIG. 5

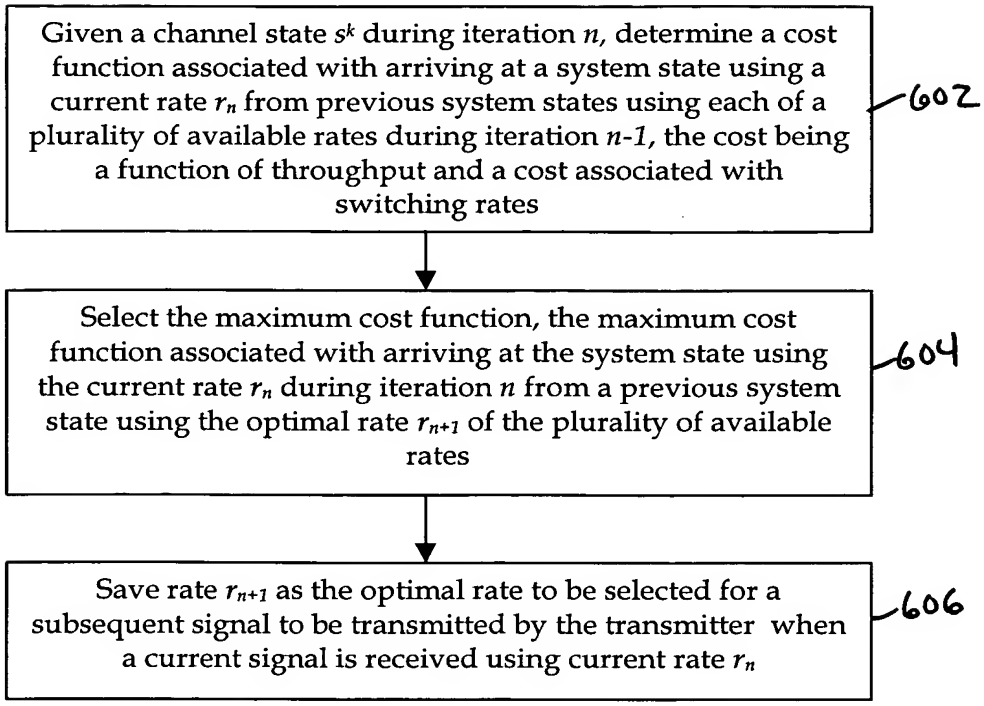
Given a channel state s^k during iteration n, determine a cost function associated with arriving at a system state using a current rate r_n from previous system states using each of a plurality of available rates during iteration $n-1$, the cost being a function of throughput and a cost associated with switching rates
602
Select the maximum cost function, the maximum cost function associated with arriving at the system state using the current rate r_n during iteration n from a previous system state using the optimal rate r_{n+1} of the plurality of available rates
604
Save rate r_{n+1} as the optimal rate to be selected for a subsequent signal to be transmitted by the transmitter when a current signal is received using current rate r_n
606

FIG. 6

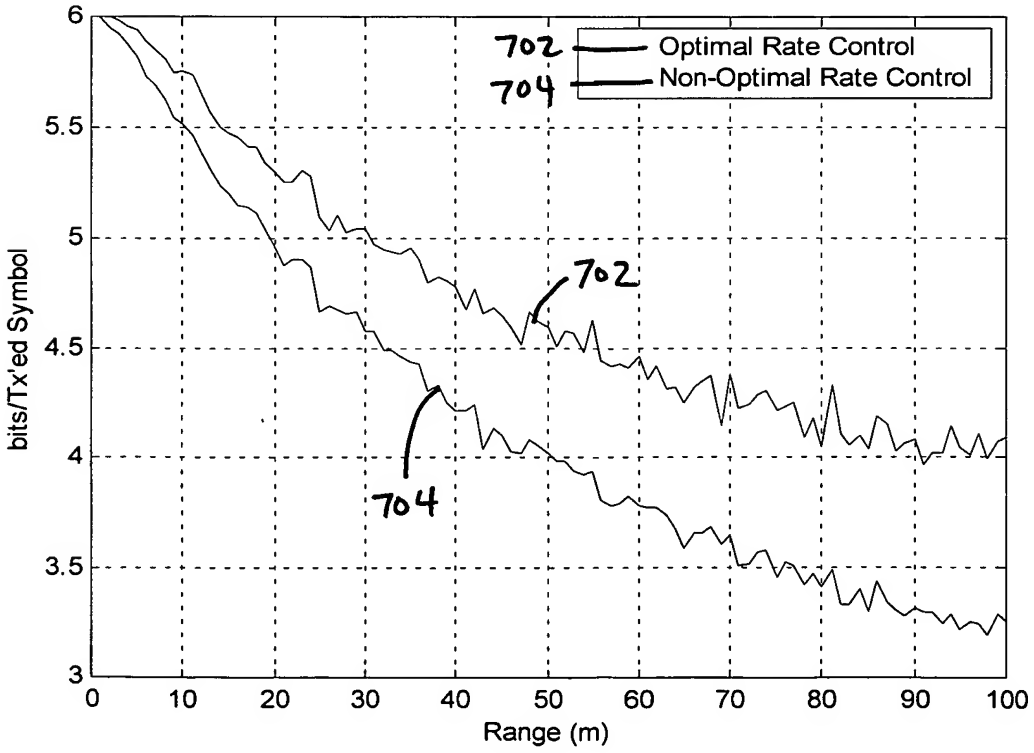
Optimal Rate Control
Non-Optimal Rate Control
702
704
bits/Tx'ed Symbol
Range (m)
6
5.5
5
4.5
4
3.5
3
0
10
20
30
40
50
60
70
80
90
100

FIG. 7

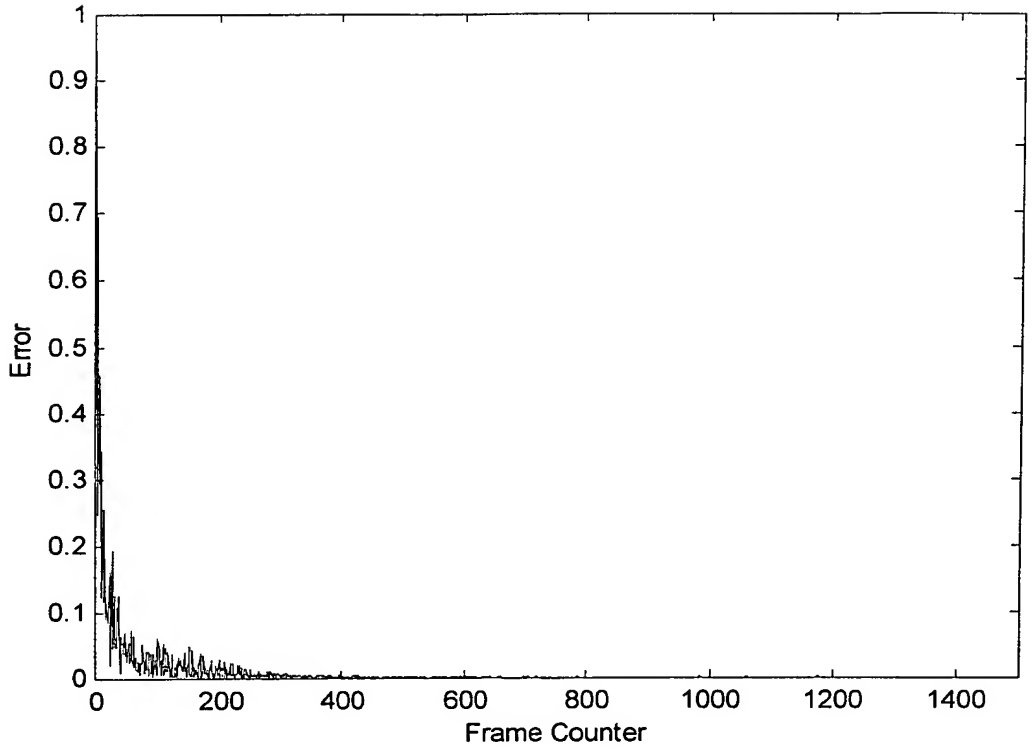
Error
Frame Counter
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
200
400
600
800
1000
1200
1400

FIG. 8

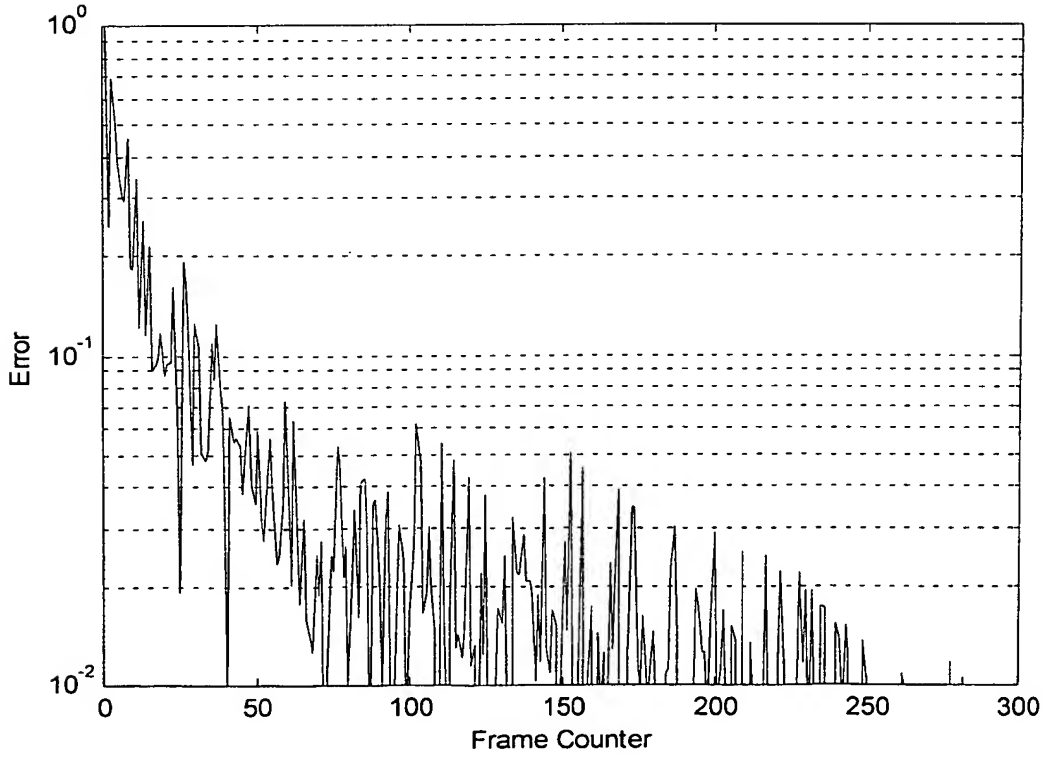
Error
Frame Counter
10^0
10^{-1}
10^{-2}
0
50
100
150
200
250
300

FIG. 9

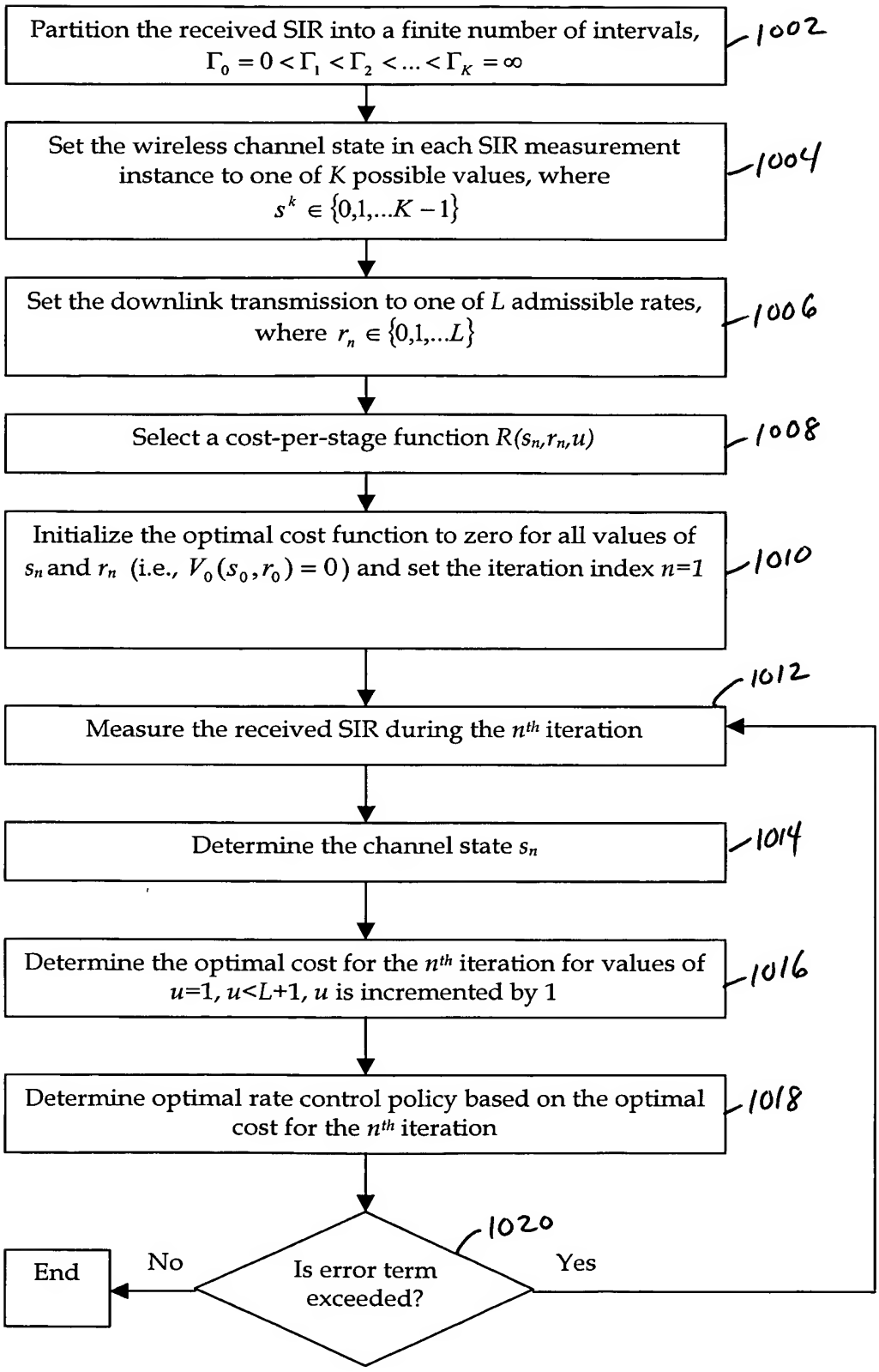
Partition the received SIR into a finite number of intervals, $\Gamma_0 = 0 < \Gamma_1 < \Gamma_2 < \ldots < \Gamma_K = \infty$
1002
Set the wireless channel state in each SIR measurement instance to one of K possible values, where $s^k \in \{0,1,\ldots K-1\}$
1004
Set the downlink transmission to one of L admissible rates, where $r_n \in \{0,1,\ldots L\}$
1006
Select a cost-per-stage function $R(s_n, r_n, u)$
1008
Initialize the optimal cost function to zero for all values of s_n and r_n (i.e., $V_0(s_0, r_0) = 0$) and set the iteration index n=1
1010
Measure the received SIR during the n^{th} iteration
1012
Determine the channel state s_n
1014
Determine the optimal cost for the n^{th} iteration for values of u=1, u<L+1, u is incremented by 1
1016
Determine optimal rate control policy based on the optimal cost for the n^{th} iteration
1018
Is error term exceeded?
1020
No
Yes
End

FIG. 10